Topic: MOTION

Motion: - A body is said to be in motion when its position changes continuously with respect to a stationary object taken as reference point. For example when the position of a car changes continuously with respect to stationary objects like houses and trees etc., we say that car is in motion.

Distance and displacement: The distance traveled by a body is the actual length of the path covered by a moving body irrespective of the direction in which the body travels. The distance traveled refers to the actual length of the indirect path whereas displacement refers to the straight line path between the initial and the final positions. When a body moves from one position to another, the shortest (straight line) distance between the initial position and the final position of the body, along with direction, is known as its displacement

i) Distance is a scalar quantity (because it has magnitude only, it has no specified direction)

ii) Displacement is a vector quantity (because it hcs magnitude a well as a direction).

Uniform and Non Uniform Motion: A body has a uniform motion if it travels equal distance in equal intervals of time, no matter how small these time intervals may be. For example, a car

running at a constant speed say, 10 metres per second, will cover equal distance of 10 metres, every second, so its motion will be uniform. Please note that the distance-time graph for uniform motion is a straight line.

A body has a non-uniform motion if it travels unequal distances in equal intervals of time. For example, if we drop a ball from the roof of a tall building, we will find that it covers unequal distances in equal intervals of time.

Speed: - The speed of a body gives us an idea of how slow or fast that body is moving. We-can now define the speed of a moving body as follows:

Speed of a body is the distance traveled by it per unit time. The speed of a body can be calculated by dividing the 'Distance travelled by the 'Time taken' to travel this distance. So, the formula for sped can be written as:

$$\text{Speed} = \frac{\text{Distance traveled}}{\text{Time taken}}$$

If a body travels a distance s in time t, then its speed v is given by:

$$V = \frac{s}{t}$$

Where v = speed, s = distance travelled and t = time taken (to travel that distance).

The SI unit of distance is meter (m) and that is second (s), - therefore, the SI unit of speed is meters per second which is written as m/s or m s^{-1}. The small values of speed are expressed in the units of centimeters per second which is written as cm/s or cm s-1. To express high speed values, we use the unit of kilometers per hour, written as km. p. h. or km/h r km h^{-1}. Speed is a scalar quantity.

The speed of running car at any instant of time is shown by an instrument called 'speedometer' which is fixed in the car.

Average Speed: The average Speed of a body is the total distance traveled divided by the total time taken to cover this distance.

Average period= Total distance traveled/Total time taken

Uniform Speed (or Constant Speed): A body has a uniform speed if it travels equal distances in equal intervals of time, no matter how small these time intervals may be. For example, a car is said o have in uniform speed of say, 60 km per hour, if it travels 30km every half hour, 15 km every quarter of an hour l km every minute, and 1 km every second.

Average speed: When we travel in a vehicle the speed of the vehicle changes from time to time depending upon the

conditions existing on the road. In such a situation, the speed is calculated by taking the ratio of the total distance travelled by the vehicle to the total time taken for the journey. This is called the average speed.

Instantaneous speed: When we say that the car travels at an average speed of 60 km/h it does not mean that the car would be moving with the speed of 60 km/h throughout the journey. The actual speed of the car may be less than or greater than the average speed at a particular instant of time.

The speed of a moving body at any particular instant of time, is called instantaneous speed.

Velocity: It is the distance traveled by it in per unit time in a given direction that is

$$\text{Velocity} = \frac{\text{Distance traveled in a given direction}}{\text{Time taken}}$$

We know that the distance traveled in a given direction is known as displacement. So, we can also write the definition of velocity in terms of displacement. We can now say that; velocity of a body is the displacement produced per unit time.

$$\text{Velocity} = \frac{\text{displacement}}{\text{Time taken}}$$

$$v = s/t$$

Where. v = velocity of the body

s = displacement of the body

t = time taken

The SI unit velocity is the same as that of speed, namely meter per second (m/s or ms^{-1}). We can use the bigger unit of kilometer per hour to express the bigger values of velocities and centimeter per second to express the small values of velocities.

Acceleration: - it is defined as the rate of change of its velocity with time that is,

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{Time taken for change}}$$

The change in velocity is the difference between the final velocity and the initial velocity. That is,

Change in velocity = final velocity - initial velocity. So,

$$\text{Acceleration} = \frac{\text{final velocity} \quad \text{initial velocity}}{\text{Time taken}}$$

The SI unit of acceleration is metre per second per second or metre per second square which is written as m/s^2 or ms^{-2}. The other units of acceleration which are also sometimes used are "centimetres per second square" (cm/s^2or $cm\ s^{-2}$) and kilometers per hour square" (km/h^2 or kmh^{-2}). When a body is moving with uniform velocity, its acceleration will be zero.

Positive Acceleration: If the velocity of an object increases then the object is said to be moving with positive acceleration. Example: A ball rolling down on an inclined plane, Negative *Acceleration*: If the velocity of an object decreases then the object is said to be moving with negative acceleration. Negative acceleration is also known as retardation or deceleration.

Example:

(1) A ball moving upon inclined plane.

(2) A ball thrown vertically upwards is moving with a negative acceleration as the velocity decreases with time.

Zero Acceleration: If the change in velocity is zero, i.e. either the object is at rest or moving with uniform velocity, then the object is said to have zero acceleration. Example: a parked car, a train moving with a constant speed of 90 km/hr. Uniform *Acceleration*: If the change in velocity in equal intervals of time is always the same, then the object is said to be moving with uniform acceleration. Example: A body falling from a height towards the surface of the earth.

Non-uniform or Variable Acceleration: If the change in velocity in equal intervals of time is not the same, then the object is said to be moving with variable acceleration.

EQUATIONS OF UNIFORMLY ACCELERATED MOTION

There are three equations of motion of those bodies which travel with uniform acceleration.

These equation give relationship between initial velocity, final velocity, time taken acceleration and distance travelled by the bodies.

Mathematical derivation

Equation I

$v = u + at$

Consider a body having the initial velocity **u** uniform acceleration **a** time taken and the final velocity **v**.

We know, $\text{Acceleration} = \dfrac{\text{change in velocity}}{\text{Time taken}}$

Or $a = \dfrac{\text{final velocity} - \text{initial velocity}}{\text{Time taken}}$

$a = \dfrac{v - u}{t}$

$at = u$

$v - u$ (by cross multiplication)

$v = u + at$ (by transposition)

Equation II: $s = ut + ½\ at^2$

We know, $\text{average velocity} = \dfrac{\text{initial velocity} + \text{final velocity}}{2}$

i.e. $$V_{av} = \frac{u + v}{2} \times t$$

But we know, Distance travelled = average velocity x time :

$$S = \frac{u + v}{2} \times t \qquad \ldots 1$$

Since, v= u + at, put the value of V in equation (1) we get

$$S = \frac{(u + u + at) \times t}{2}$$

$$= \frac{(2u + at) \times t}{2}$$

$$= \frac{2ut + at^2}{2}$$

$$S = ut + \frac{1}{2} at^2$$

This is used to calculate distance travelled by The body in time t.

Equation III

$2as$ ' = $v^2 - u^2$

We know, Distance travelled = average velocity x time

$$S = \frac{u + v}{2} \times t \qquad \ldots 1$$

We know, $v = u + at$ '

$at = v - u$

Or $t = \frac{v - u}{a}$

put the value of' 't' in equation, (1) we get,

$S = \frac{(u + v) \times (v - u)}{2a}$

$= \frac{(v + u)(v-u)}{2a}$

$2as = v^2 - u^2$ using identity $(a - b)(a + b) = a^2 + b^2$

To derive v - u + at by graphical Method: -

To Derive $s = ut + \underline{l/2}\ at^2$ by graphical Method: -

Suppose the body travels a distance s in time t^ In figure /the distance traveled by the body is given by the area of the space between the velocity-time graph AB and the time axis OC, which is equal to the area of the figure OABC. Thus:

Distance traveled = Area of the figure OABC

= Area of rectangle OADC + Area of triangle ABD

We will now find out the area of the rectangle OADC and th;e area of the triangle ABD. :

(i) Area of rectangle OADC = OA x OC (see figure)

= u x t

= ut ...(5)

(ii) Area of triangle ABD = $\underline{1/2}$ x Area of rectangle AEBD

= ½ x AD x BD

= ½ x t x at (because AD = t and BD = at)

= ½ at^2 ...(6)

So, Distance traveled, s = Area of rectangle OADC + Area of triangle ABD or,

or, $s = ut + 1/2at^2$

To Derive $V^2 = u^2 + 2as$ by Graphical Method:

The Distance traveled s by a body in time t is given by the area of the figure OABC which is a trapezium (see figure 20). In other words,

Distance traveled s = Area of trapezium OABC

$$s = \frac{(\text{Sum of parallel sides x Height})}{2}$$

or, $$s = \frac{(OA + CBV) \text{ x } OC}{2}$$

Now, OA + CB = u + v and OC = t. Putting these values in the above relation, we get

$s = (u + v) \text{ x } t$ ...(7)

Consider the velocity-time graph of a body shown in figure 20. The body has an initial velocity u at point A and then its velocity

changes at a uniform rate from A to B in time t. In other words, there is a uniform acceleration a from A to B, and after time t its final, velocity becomes v which is equal to BC in the graph (see Figure -).The time t is represented by;OC. To complete the figure, we draw the perpendicular CB from point C, and draw AD parallel to OC. BE is the perpendicular from point B to OE.

Now, initial Velocity of the body, u= OA ...(1)

And, Final velocity of the body, v = BC ....(2)

But from the graph BC = BD + DC

Therefore, v = BD + DC ....(3)

Again DC = OA

So, v = BD + OA

Now, From equation (1), OA = u

So, v = BD + u .....(4)

We should find out the value of BD now. We know at the slope of a velocity-time graph is equal to acceleration, a.

Thus, Acceleration, a = slope of line AB (see figure-20)

or, $$a = \frac{BD}{AD}$$

But AD = OC = t (see f igure20), so putting t in place of AD in the above relation, we get:

$$a = \frac{BD}{t}$$

$$BD = at$$

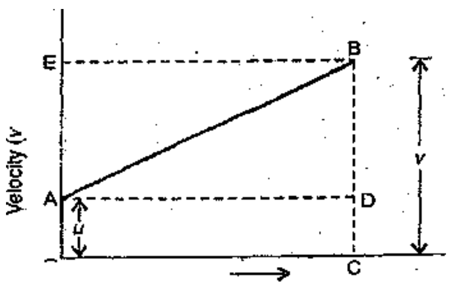
Now, putting this value of BD in equation (4) we get:

$$v = at + u$$

This equation can be rearranged to give:

$$v = u + at$$

And this is the first equation of motion. It has been derived here by the graphical method.



We now want to eliminate t from the above equation. This can be done by obtaining the value of t from the first equation of motion

Thus, $v = u + at$ (First equation of motion).

And, $at = v - u$

So, $t = (v - u)/a$

Now, putting this value of t in equation (7) above, we get:

$$s = \frac{(u + v) * (V - u)}{2a}$$

or, $2as = v^2 - u^2$ (because $(v + u) \times (v - u) = v^2 - u^2$)

or, $v2 - u2 = 2as$.

Circular motion: When a point object is moving on a circular path with a constant speed (i. e. it covers equal distances on the circumference of the circle in equal intervals of time), then the motion of the object is said to be a uniform circular motion. In uniform circular motion, the velocity of the object (represented by the tangent to the circular path at a given instant) is changing its direction continuously, hence it is a case of uniformly accelerated motion. When a body takes one round of circular path, then it travels a distance equal to its 'circumference1 which is given by 2Πr, where r is the radius of circular path. The speed of the body moving along a circular path is given by the formula:

$V = 2\Pi r/t$

Where v is speed, r is radius of the circular path and t is the time taken for one round of circular path. Examples of Uniform Circular Motion;-

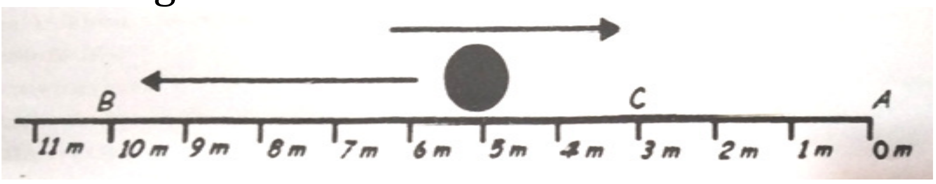
1. Artificial satellites move under uniform circular motion around the earth.
2. The tip of second hand of a watch exhibits uniform circular motion on the circular dial of the watch.
3. An athlete moving on a circular track with a constant speed exhibits uniform circular motion.

NCERT Solution

Solution of In Text Questions:

Q1) An object has moved through a distance. Can it have zero displacement? If yes, support your answer with an example.

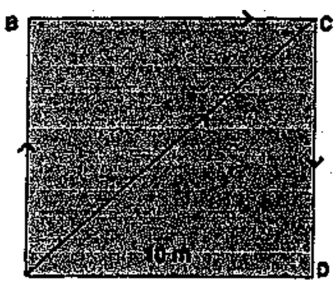
A) Yes, zero displacement is possible if an object has moved through a distance.



Suppose a ball starts moving from point A and it returns back at same point A, then the distance will be equal to 20 meters while displacement will be zero.

Q2) *A farmer moves along the boundary of a square field of side 10 m in 40 s. What will be the magnitude of displacement of the farmer at the end of 2 minutes 20 seconds from his initial position?*

A)



Given, side of the square field = 10m

Therefore, perimeter = 10 m x 4 = 40 m

Farmer moves along the boundary in 40s.

Displacement after 2 m 20 s - 2 x 60 s + 20 s = 140 s =?

Since in 40 s farmer moves 40 m

Q9) When will you say a body is in………………

(i) A body is said in *uniform acceleration* when its motion is along a straight line and its velocity changes by equal magnitude in equal interval of time;

(ii)A body is said in *non-uniform acceleration* when its motion is along a straight line and its velocity changes by unequal magnitude in equal interval of time.

Q10) *A bus decreases its speed from 80 km/h to 60 km/h in 5 s……*

A) Here we have u = 80km/hr , v= 60km/hr, t= 5s

Therefore acceleration a = ?

We know that v = u + at

= 60km/hr = 80km/hr + a + 5s

60km/hr - 80km/hr = a x 5s

20km/hr = a x 5s

$$a = \frac{20km/hr}{5s}$$

a = 4km/h/s

Therefore acceleration is 4km/h/s or -1.1 m/s^2

Q11) A train starts from a railway station and moving with….

A) Here we have,

Initial velocity, u = 0,

Final velocity, v = 40km/h = 11.llm/s

Time (t) = 10 minute = 60xlO=6OOs

Acceleration (a) =?

We know that v = u + at

40km/hr = 0km/hr + a x 10m

11.11m/s = a x 600

$$a = \frac{11.11m/s}{600s}$$

$a = 0.0185m/s^2$

Q12)*What is the nature of the distance-time graphs for……………..*

A (a) The slope of the distance-time graph for an object in uniform motion is straight line.

(b) The slope of the distance-time graph for an object in non-uniform motion is not a straight line

Therefore in 1s distance covered by farmer = 40/40m = 1m

Therefore in 140s distance covered by farmer = 1x140m = 140m

Now, number of rotation to cover 140 along the boundary =

$$\frac{\text{Total distance}}{\text{Perimeter}}$$

Thus after 3.5 rounds farmer will be at point C of the field

Therefore, Displacement AC = $\sqrt{(10m)^2 + (10m)^2}$

= $\sqrt{100m^2 + 100m2}$

$= \sqrt{200\text{m}^2}$

$= \sqrt{2 \text{ x } 100\text{m}^2}$

$= 10\sqrt{2}\text{m}$

Thus, after 2 minutes 20 second the displacement of farmer will be equal to 10 √2m northeast from initial position.

Q3) *Which of the following is true for displacement?........*

A) None

Q4) *Distinguish between speed and velocity*

A:Speed has only magnitude while velocity has both magnitude and direction.

Q5) Under what conditions is the magnitude of average velocity of an object equal to its average speed?

A) The magnitude of average velocity of an object will be equal to its average speed in the condition of uniform velocity.

Q6) What does the odometer of an automobile measure?

A) In automobiles, odometer is used to measure the distance.

Q7) What does the path of an object look like when it is in uniform motion?

A) In the case of uniform motion the path of an object will look like a straight line.

Solution of In Text Questions - 2

Q8) During an experiment, a signal from a spaceship reached………

A) Here we have speed = 3×10^{8} ms^{-1}

Time = 5 minutes = 5 x 60s = 300s

We know that, Distance = Speed x Time

Distance = 3×10^{8} ms^{-1} x 300s = 1800×10^{8} = 18×10^{11}m

Answer:

Here we have,

Initial velocity, u = 90km/hr = $\frac{90 \times 1000m}{60 \times 60s}$ = 25m/s

Final velocity, v = 0

Acceleration a = $0.5m/s^{2}$

Therefore, distance travelled = ?

We know that $v^{2} = u^{2} + 2as$

$0^{2} = (25)^{2} + 2\,(-0.5m) \times s$

625 = -1 x5

s = $-\frac{625}{-1}$

= 625m

Therefore, train will go 625m before it brought to rest.

Q18) A trolley, while going down an inclined plane, has an…………..

A) Here we have

Initial velocity, u = 0

Acceleration (a) = $2cm/s^2 = 0.02m/S^2$

Time (t) = 3s

Therefore, Final velocity, v =?

we know that, v = u + at

Therefore, v = 0 + $0.02m/s^2$ x 3s

v = 0.06m/s

Therefore the final velocity of trolley will be 0.06m/s after start.

Q19) A racing car has a uniform acceleration of 4 m s"2…………

A) Here we have,

Acceleration, a = $4m/s^2$

Initial velocity, u =0

Time, t = 10s

Therefore, Distance (s) covered =?

We know that $s = ut + ½ at^2$

$s = 0 \times 10s + ½ \times 4m/s^2 \times (10s)^2$

s = 2 x 100m = 200m

Thus, racing car will cover a distance of 200m after start in 10s with given acceleration.

Q13) What can you say about the motion of an object whose distance graph is a straight line parallel to the time axis?

a) When the slope of a speed time graph is a straight line parallel to the time axis, the object is moving with uniform

motion.

Q14) What can you say about the motion of an object if its speed-time graph is a straight line parallel to the time axis?

A) When the slope of a speed time graph is a straight line parallel to the time axis, the object is moving with uniform speed.

Solution of In Text Questions 3

Q15) What is the quantity which is measured by the area occupied below the velocity-time graph?

A) The quantity of distance is measured by the area occupied below the velocity time graph.

Q16) A bus starting from rest moves with a uniform acceleration of 0.1 ms^2 for 2 minutes. Find (a) the speed acquired, (b) the distance travelled.

A: Here we have,

Initial velocity (u) = 0

Acceleration (a) = $O.lms^{-2}$

Time (t) = 2 minute = 120 second

(a) The speed acquired:

We know that, v = u + at

v = 0 + $O.lm/s^2$ x 120 s ,

v= 120m/s

Thus, the bus will acquire a speed of 120 m/s after 2 minute with the given acceleration.

(b) The distance travelled:

We know s = u + ½ at^2

0 x 120s + ½ 0.1 m/s^2 x $(120s)^2$

½ x 14400m = 7200m or 7.2 km

Thus, bus will travel a distance of 7200m or 7.2km in the given time of 2 minutes.

Do Q17 yourself.

Q20) A stone is thrown in a vertically upward direction with a velocity of $5ms^1$. ……………..

A) Here we have

Initial velocity (u) = 5m/s

Final velocity (v) =0 (Since from where stone starts falling its velocity will become zero)

Acceleration (a) = $-10m/s^2$

(Since given acceleration is in downward direction, i.e. the velocity of the stone is decreasing, thus acceleration is taken as negative)

Height, i.e. Distance, s =? Time (t) taken to reach the height =?

We know that, $v^2 = u^2 = 2as$

$0 = (5/m/s)^2 + 2 \times 10\ m/s^2 \times s$

$0 = 25\ m^2s^2 - 20m/s^2 \times s^2$

$s = \dfrac{25\ m^2s^2}{20m/s^2}$

$s = 1.25m^2$

now we know that v = u + at

$0 = 5ms^{-1} + (-10ms^{-2}) \times t$

$0 = 5ms^{-1} - 10ms^{-2} \times t$

$t = \dfrac{5m\ s^{-1}}{10ms^{-2}} = ½\ s = 0.5s$

Thus stone will attain a height of 1.25m and time taken to attain the height is 0.5s.

Solution of NCERT Exercise (Part 1)

1. An athlete completes one round of a circular track of…………….

a) Here we have,

Diameter = 200 m, therefore, radius = 200m/2 - 100 m

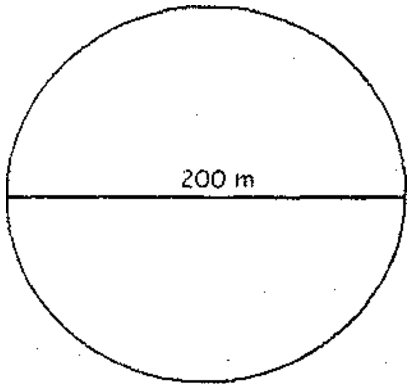
Time of one rotation = 40s

Time after 2m20s = 2 x 60s + 20s - 140s

Distance after 140s = ?

Displacement after 140s =? .

MOTION



Circular track with diameter of 200 in

we know that velocity along a circular path = $\frac{\text{circumference}}{\text{time}}$

$= 2\Pi r / 40s$

$= \frac{2 \times 314 \times 100m}{40s}$

(a) Distance after 140s

We know that,distance=velocity x time

distance=15.7m/s xl40 s = 2198 m

(b) Displacement after 2 m 20 s i.e. in 140 s

Since,rotation in 40 s=l

Therefore, rotation in 1 s = 1/40

Therefore, rotation in 140s = 1/40 x 140 = 3.5

Therefore, in 3.5 rotations athlete will be just at the opposite side of the circular track, i.e. at a distance equal to the diameter of the circular track which is equal to 200 m.

Therefore,

Distance covered in 2 m 20 s = 2198 m

And, displacement after 2 m 20 s = 200m

2. Joseph jogs from one end A to the other end B of a straight……

Do it yourself

4. *A motorboat starting from rest on a lake accelerates………*

A) Here we have, ,

Initial velocity (u) = 0

Acceleration (a) = $3.0 m/S^2$

Time = 8 s <

Therefore, distance (s) covered =? ;

We know that, $s = ut + ½ at^2$

$s = 0 x 8 + ½ 3m/S^2 x (8s)^2$

s= ½ x 3 x64m

s = 3 x 32m

s = 96m

Therefore, boat travels a distance of 96 m in the given time.

5. A driver of a car travelling at 52 km/h applies the brakes……..

A) Given for first driver,

Here we have,

Distance from point A to B = 300 m

Time taken = 2 minute 30 second = 2 x 60 + 30 s - 150 s

Distance from point B to C = 100 m

Time taken = 1 minute = 60 s

(a) Average speed and velocity from point A to B

We know the Average speed = $\frac{\text{Total distance covered}}{\text{Total time taken}}$

Average speed = 300m/150s

Therefore velocity = 2m/s east

(b) Average speed and velocity from B to C

We know the Average speed = $\frac{\text{Total distance covered}}{\text{Total time taken}}$

Average speed = 100m/60s

Therefore velocity = 1.66m/s east

Therefore, average velocity=1.66 m/S west

3. Abdul, while driving to school, computes the average……….

A) *Strategy*: We need to calculate the time taken in each of the' trip. After that, we can

calculate the average speed.

Let the distance of the school = s km

Let time to reach the school in first trip = t_1

Let time to reach the school in second trip = t_2

Thus, distance covered by first car = area of $\triangle$OAD

Distance S = ½ x 14.4m/s x 5s = 7.2 m/s x 5s = 36m

Thus, distance covered by second car = area of $\triangle$OBC

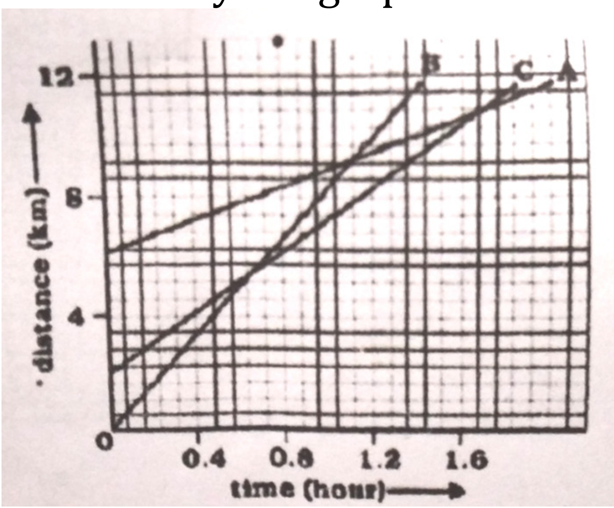
Distance = ½ x OC x OB

s = ½ x 9.4m/s x 10s = 47m

Therefore second car travelled faster.

Solution of NCERT Exercise (Part 2)

6. Fig 8.11 shows the distance-time graph of three objects A,B and C. Study the graph and answer the following questions:



(a) Which of the three is travelling the fastest?

(b) Are all three ever at the same point on the rood?

(c) How far has C travelled when B passes A?

(d) How far has B travelled by the time it passes C?

A) Initial velocity, u= 52km/hr = $\frac{52 \times 1000m}{60 \times 60s}$ = 14.4ms^2

Final velocity = 0 (Since car stops)

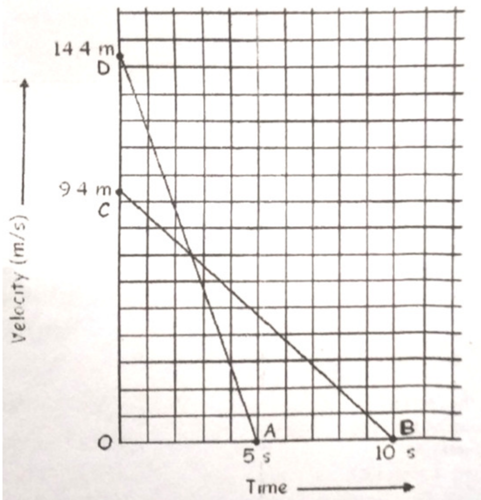
Therefore, distances = ?

Given for second driver

Initial velocity $u = 3km/h = \frac{3000m}{60 \times 60s} = 9.4ms^{-1}$

Time $t = 10s$

Final velocity, $v = 0$



In the graph, blue slope shows the velocity of the first car and green slope shows the velocity

of the second car. ;

Distance is calculated by the area under the slope of the graph.

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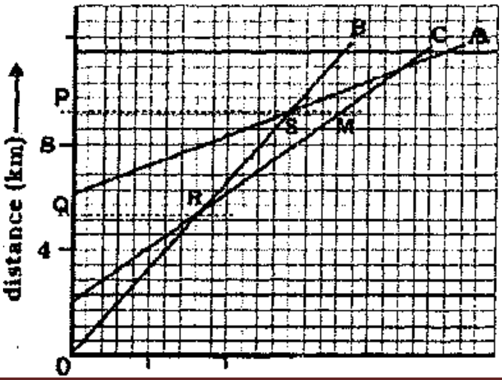


0.4 0.8 1.2 1.6

time (hour)-----^

(a) It is clear from graph that B covers more distance in less time. Therefore, B is the fastest.

(b) All of them never come at the same point at the same time.

(c) According to graph; each small division shows about 0.57 km. A is passing B at point S which is in line with point P (on the distance axis) and shows about

9.14 km

Thus, at this point C travels about

9.14 - (0.57 x 3.75) km = 9.14 km - 2.1375 km - 7.0025 km ».7 km................

Thus, when A passes B, C travels about 7 km.

(d) B passes C at point Q at the distance axis which is * 4km + 0.57km x 2.25 = 5.28 km Therefore, B travelled about 5.28 km when passes to C.

7. *A ball is gently dropped from a height of 2C m*………

Here we have,

Initial velocity u=0

Distance, s=20m

Acceleration, a =10 m s^{-2}

Final velocity, v=?

Time, t= ?

Calculation of Final Velocity: v

We know that $v^2 = u^2 + 2as$

$v^2 = 0 + 2 \times 10m/s^2 \times 20m$

$v^2 = 400m^2s^2$

$v = \sqrt{400m^2s^2}$

$v = 20m/s^2$

Calculation of time t

We know that $v = u + at$

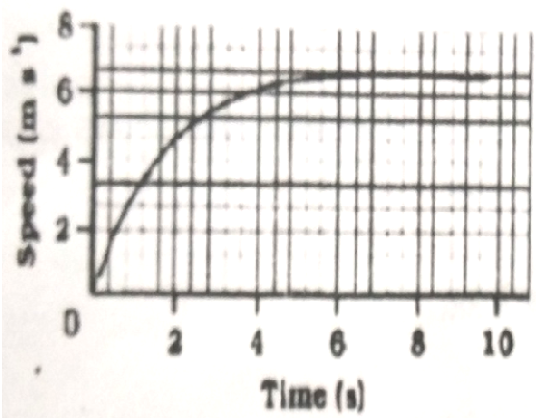
$20ms^{-1} = 0 + 10ms^{-2} \times t$

$t = 20ms^{-1}/40ms^{-2} = 2s$

Therefore

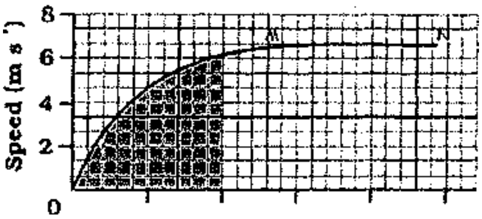
Ball will strike the ground at the velocity of $20ms^{-1}$
Time taken to reach at the ground = 2s

8. The speed-time graph for a car is shown is Fig.



(a) Find how far does the car travel in the first 4 seconds………

Answer:



4 6 S 10

Time

(a) Distance travelled by car in the 4 second -

The area under the slope of the speed - time graph gives the distance travelled by an object.

In the given graph

Six full squares and 12 half squares come under the area slope for the time of 4 second.

Total number of squares = 56 ÷ 12/2 = 62 squares

The total area of the squares will give the distance travelled by the car in 4 second.

On the time axis the squares = 2s

Therefore squares = 2/5 s

On the speed axis the squares = 2m/s

Thus area of 1 square = 2/5s x 2/3 m/s = 4/15m

Therefore area of 62 squares =4/15m x 62

248/15m = 16.53m

Therefore, car travels 16.53m in first 4 seconds.

(b) Part MN of the slope of the graph is straight- line parallel to the time axis, thus this portion of graph represents uniform motion, of car.

9. State which of the following situations are possible and…….

A) The term acceleration implies that the velocity of the object is changing inspite of that constant acceleration with zet-u velocity is impossible. When an object is thrown in upward direction, at the maximum height the velocity of the object becomes zero but still in that condition a constant acceleration due to gravity is working.

(b) Object moving in a certain direction with an acceleration in perpendicular direction is possible; in case of circular motion. When an object moves on a circular path, its direction is along. the tangent of the circle but acceleration is towards the radius of the circle. We know, that a tangent always makes a right angle with the radius; so when an object is in circular motion, the acceleration and velocity are in mutually perpendicular direction.

10. An artificial satellite is moving in a circular orbit…….

A) Here we have, .

Radius, r = 42250km >

Time, t- 24 hours

Speed =?

We know that velocity on a circular path = $\frac{2\Pi r}{\text{time}}$

$$= 2 \times 22/7 \times 42250\text{km}/ 24\text{hr}$$

$$= \frac{2 \times 22 \times 42250}{7 \times 24} \text{ km/hr}$$

$$v = 11065.47 \text{ km/hr}$$